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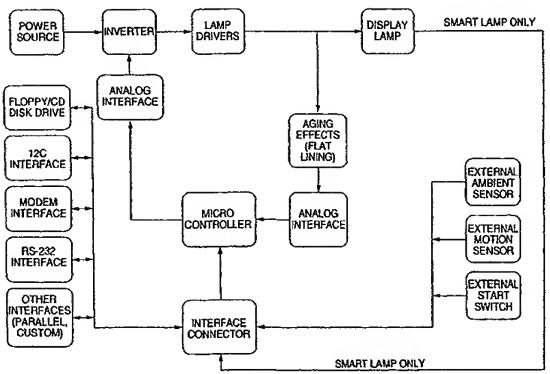
(54) Title: REMOTELY PROGRAMMABLE CONTROL DEVICE FOR USE IN ELECTROLUMINESCENT DISPLAYS AND LIGHTING SYSTEMS



(57) Abstract: Described is a remotely programmable control device (100) for use in electroluminescent display and lighting applications. Elements of this invention include a power supply (101), various inverters/wave form conditioners, a motherboard (201), inbound/outbound communications means (113), motion-sensing devices (117), ambient light sensor (116), and a floppy disk reader (111). Remote programmability is achieved through several methods including detecting the driving instructions from the lamp display itself, or downloading data from a remote network or a floppy disk.

WO 01/27909 A1

REMOTELY PROGRAMMABLE CONTROL DEVICE FOR USE IN ELECTROLUMINESCENT DISPLAYS AND LIGHTING SYSTEMS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to controllers for electroluminescent display and lighting systems. More particularly, the present invention relates to remotely programmable controllers for electroluminescent display and lighting systems.

Description of the Related Art

Electroluminescent display and lighting systems are presently known. A typical electroluminescent display system combines one or more electroluminescent lamps or other electroluminescent display elements with an electronic driver or controller. Often various graphical or artistic elements such as overlays are laminated onto the lamps. These systems can resemble circuits in that the display elements are segmented into various areas that are independently addressable. Power and wave form is delivered to the display elements by an electronic driver which also delivers display control through a series of electronic impulses that are sent through one or many channels that act as wiring for the circuit. These channels are mapped to the display element through a connection and subsequently, through pre-printed traces that address each independent area of the display.

Existing electroluminescent lamp controllers contain a microprocessor that contains pre-programmed instructions that control the sequence of impulses that are sent from the controller to the display element, thereby allowing the electroluminescent system to serve

a single, useful purpose. These microprocessors are resident in the controllers, and have been pre-programmed at a factory or distributor. The instructions that comprise the program are therefore fixed, having in essence been previously hard-wired by humans at an industrial site that is often distant from the place where the electroluminescent system is intended to be deployed. The microprocessor is the heart of the controller, and since it is very difficult to easily modify this electronic part, the controller is therefore relegated to a single purpose or a one-time use.

There are several known problems with controllers that use the architecture described above. First, since it is difficult to modify these devices, they tend to be dedicated to a single display device. Reworking these controllers requires shipment to an industrial facility, wherein the microprocessors must be physically replaced or reprogrammed when possible or discarded. This process requires time and effort, and carries a significant cost to replace the microprocessor. Since it is very difficult to know in advance the object (or program) for each display element that will be manufactured in the future, it is difficult to build an inventory of electronic devices that can rapidly satisfy customers' differing demands for the various display systems. Accordingly, the costs for these electroluminescent systems are higher than they would be if a more flexible, reusable electronic controller were in use. Because there is much shipment and other physical movement of existing controllers, breakage and loss is relatively high.

SUMMARY OF THE INVENTION

The invention described herein remedies many known controller problems by substituting a remotely programmable computer in place of the microprocessor. This computer, called the motherboard, allows the controller to generically control any electroluminescent display system, and it permits the controller to be immediately reusable, without movement, for any subsequent display. The motherboard is remotely programmable either by a series of instructions carried within the display system itself, or by instructions that are downloaded into the controller from a wireless device and/or a telephonic connection.

The invention uses elements and components that are readily available, but it incorporates these components into a unique architecture, that has never before existed in connection with electroluminescent display and lighting systems. The invention and architecture solve many problems that have hitherto existed with electroluminescent controllers, and use of the invention will convey many economic and logistical benefits to both manufacturers and end-users of electroluminescent display and lighting systems. This, in turn, will help lower the cost of these systems, will make them more profitable for manufacturers. It will also make these systems easier to use. The conjoined benefits that are derived from this invention will therefore cause the market for these systems to greatly expand.

Brief Description of the Drawings

Figure 1 is a control system block diagram of an embodiment of the present invention.

Figure 2 illustrates one embodiment of the invention in which the microcomputer is programmed or receives information through use of an external memory device.

Figure 3 illustrates a further embodiment of the invention in which a remote network connection way allows communication and/or interaction with the microcontroller.

Figure 4 depicts remote, wireless programming of a microcontroller in an embodiment of the invention.

Figure 5 depicts a further embodiment of the invention in which the interface with the microcontroller comprises a floppy disk or other external storage media.

Figure 6 illustrates yet another embodiment of the present invention in which the microcontroller receives information through detecting the driving instructions from the lamp display itself.

DESCRIPTION OF THE INVENTION

In one embodiment of the present invention, the controller comprises or consists of a motherboard, a power supply, and various inverters and waveform conditioners. The controller may also include inbound/outbound communications facilities, motion sensing

apparatus, ambient lighting detection, scanning/flatlining techniques, a floppy disk reader and internal storage devices.

In an embodiment of the invention in which the controller uses flatlining techniques the controller includes a photosensor or other means for determining the lamp brightness. The photosensor is positioned to monitor the brightness of the electroluminescent lamp. Should the lamp brightness diminish to a certain extent or to a particular brightness the lamp voltage is increased to maintain brightness over time. The flatlining techniques can be implemented by providing electronic sensing circuits which monitor the electroluminescent cells of the lamp and make adjustments to compensate for variations in the contrast between the cells, while maintaining a fixed contrast between the lamp luminance and the ambient lighting. In this embodiment, separate feedback loops monitor the ambient lighting, the cell luminance, and the frequency of the excitation voltage and make appropriate adjustments to an adjustable luminance reference. The adjustments occur while a microprocessor sequences through an assortment of electroluminescent cells of various sizes. In another embodiment, instead of having a feedback loop to monitor the lamp luminance as it decreases due to aging, the circuit which drives the EL lamp includes a timer and a microprocessor. The timer measures the elapsed time during which the EL display has been operating. The microprocessor adjusts the drive signal to the EL display to compensate its brightness to be independent of its age, based on the elapsed time measured by the timer and an empirically-determined aging parameter. This process for maintaining a necessary lamp brightness is described in greater detail in the commonly owned U.S. Application No. 09/497,607 filed on March 2, 2000, which application is incorporated by reference.

The purpose of the motherboard is to accept a series of instructions and to transmit these instructions to the display element throughout the life of the particular application. The instructions can come from a remote storage repository.

The inverters and waveform conditioners are regulated by the motherboard to produce the electrical characteristics specifically required by the display.

Inbound communications devices may be used to initially receive a program, or to reprogram the motherboard and/or display while the controller is in use. Outbound communications may be employed to send messages and/or data to a remote location. An embodiment of a system for controlling an electroluminescent lamp is illustrated in Figure 1. Microcontroller 100 is central to the workings of a sequencing or otherwise programmed electroluminescent lamp. Data is received by microcontroller 100 through interface connector 110. The data is transmitted by a plurality of interfaces and sensors. For example, in the embodiment illustrated in figure 1, potential interfaces include floppy disk/CD drive 111, 12C interface 112, modem interface 113, RS-232 interface 114 and other interfaces 115. Floppy disk or CD-ROM drive 111 may be used as an alternate means to initially program the system, to reprogram the system or to load data into the system. Data from these interfaces is transmitted to interface controller 110 and to microcontroller 100. In addition, external ambient sensor 116, external motion sensor 117 and external start switch 118 transmit information to interface controller 110 and thus to microcontroller 100. Motion sensor 117 may be used to help determine how the system should react when an animate object approaches it. Ambient sensor 116 may be used to regulate the system, the power consumed or other features of the display. Aging effects compensation and flatlining apparatus 119 is also connected with microcontroller 100

through analog interface 130. Scanning and/or flatlining techniques may be used to enhance the life of the system or display, or to otherwise improve the system's performance. In this embodiment, a further analog interface 131 allows microcontroller 100 to communicate with inverter 140 and hence lamp drivers 151. Lamp drivers 151 control display lamp 150.

In the present invention, as shown in Figure 1, display lamp assembly 150 provides input to microcontroller 100 through interface connector 110. Information transmitted by display lamp 150 can be used to program the motherboard in microcontroller 100.

Power source 101 supplies power for the elements of the lamp assembly. The power supply can comprise 110-240V AC or batteries or other appropriate power supplies. The power supply conveys an electrical current for the system.

Figure 2 illustrates the connection between microcontroller 100 and electroluminescent lamp 150. Microcontroller 100 comprises microcomputer or motherboard 201 and memory input/output port 202. Microcontroller 100 is connected with controller connector 204 by cable 203. Controller connector 204 and lamp connector 205 are in communication. Lamp connector 205 is connected with display lamp 150 by cable 206. Further, in this embodiment program memory 207 is connected with lamp connector 205. Program memory 207 provides programming or data to microcomputer 201, which in turn controls lamp 150.

Internal storage devices may be used to contain programs and/or data that are useful to the motherboard and/or the display device.

There are numerous proposed ways to communicate and/or interact with the motherboard of the present invention. One method involves attaching an external memory device, such as program memory 207 or a flash memory card to the display element. When the motherboard senses a new device, or discovers that an existing device has been removed, it will attempt to establish a connection with the display device in an effort to load and/or initiate a new set of programming instructions. There are many existing devices that can be carried on board the display element in the manner shown by Figure 2.

Figure 3 illustrates another way to allow communication and/or interaction with microcontroller 100. In this method a remote network connection is used. Phone jack 304 and communications adapter or modem 301 may be fitted to microcontroller 100 and telephone dialing and answering facilities. Microcontroller 100 can therefore be accessed remotely by phone, and receive programming and/or data by download. Alternatively, microcontroller 100 can itself sense the need for a new program and/or data, and can initiate the connection to either upload information that it contains, or to request downloaded programs and/or data. Microcontroller 100 is connected with lamp 150 by cable 302.

Figure 4 illustrates remote, wireless programming of microcontroller 100. In this embodiment transmitter 400 programs the controller. Transmitter 400 can be remote to the controller and wireless. Transmitter 400 may be carried on-board the electroluminescent system, or may be positioned in another accessible area, or may be transported by hand. In this embodiment of the invention microcontroller 100 includes receiver 401 through which microcontroller 100 receives the programming information transmitted by transmitter 400.

Figure 5 depicts a further embodiment of the invention in which the interface with microcontroller 100 comprises floppy disk 500. Floppy disk 500 is inserted into floppy disk drive 501. Alternately the interface can comprise a CD/ROM or other external storage media that can be inserted into a drive on the controller in order to program the motherboard, download and/or upload data.

Figure 6 illustrates an embodiment of the present invention in which display lamp 150 contains magnetic or optical encoding and/or other data storage schemes such that microcontroller 100 can download programs, instructions and/or data directly from display lamp 150. In this embodiment display lamp 150 has, in effect, been transformed into a floppy disk and therefore, serves a dual purpose. Display lamp 150 includes printed circuitry 603 and reader strip 601 that can be inserted into reader 600 that is associated with microcontroller 100. Pin connector 602 allows the connection between display lamp circuitry 603 and reader 600.

The display element itself can contain magnetic electrical or optical encoding and/or other data storage schemes.

We claim:

1. A controller for an electroluminescent display or lighting system, the controller comprising:
   a motherboard;
   one or more inverters;
   one or more waveform conditioners.

2. The controller described in claim 1, further comprising means for receiving information.

3. The controller described in claim 2, wherein the information received by the controller comprises programming or sequencing instructions for the electroluminescent display or lighting system.

4. The controller described in claim 2, wherein the means for receiving information comprise a modem interface.

5. The controller described in claim 2, wherein the controller further comprises a transmitter and wherein the means for receiving information comprise a receiver that is adapted to receive remote wireless communication from the transmitter.

6. The controller described in claim 2, wherein the means for receiving information comprise a floppy disk, CD-ROM or other external storage media drive.

7. The controller described in claim 2, further comprising means for transmitting information.

8. The controller described in claim 2, further comprising motion sensing apparatus.

9. The controller described in claim 2, further comprising means for detection of lamp brightness and means for varying the lamp voltage to produce a desired lamp brightness.

10. The controller described in claim 2, further comprising means for ambient lighting detection.

11. The controller described in claim 10, further comprising means for detection of lamp brightness and means for varying the lamp voltage to produce a desired lamp brightness.

12. An electroluminescent display system comprising:
an electroluminescent lamp assembly including means for data storage; and,
a controller including means for downloading data stored in the electroluminescent lamp assembly.

13. The electroluminescent display system described in claim 12, wherein the means for data storage comprise a reader strip which is magnetically, electrically, mechanically or optically encoded and wherein the means for downloading data comprise a reader.

14. The electroluminescent display system described in claim 12, wherein the electroluminescent lamp assembly further includes printed circuitry and a reader strip, wherein the controller further includes a reader and pin connectors and wherein the printed circuitry is adapted to be attached with the reader using the pin connectors.

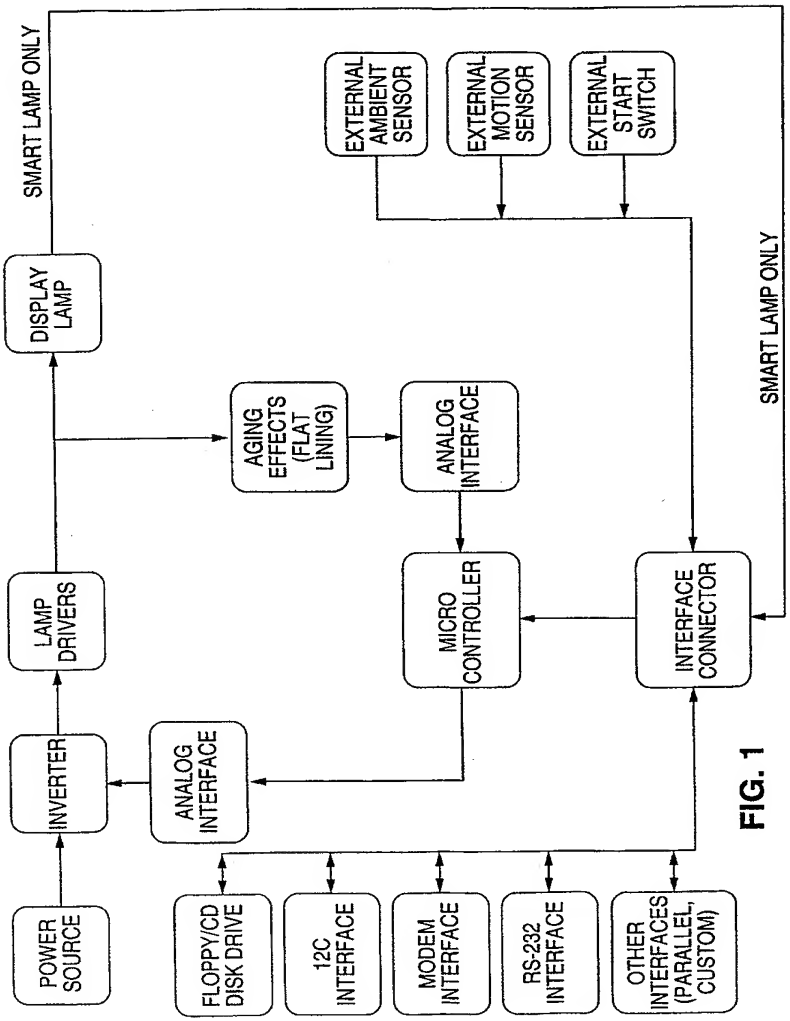

SMART LAMP ONLY
EXTERNAL AMBIENT SENSOR
EXTERNAL MOTION SENSOR
EXTERNAL START SWITCH
DISPLAY LAMP
SMART LAMP ONLY
AGING EFFECTS (FLAT LINING)
ANALOG INTERFACE
LAMP DRIVERS
MICRO CONTROLLER
INTERFACE CONNECTOR
INVERTER
ANALOG INTERFACE
POWER SOURCE
FLOPPY/CD DISK DRIVE
12C INTERFACE
MODEM INTERFACE
RS-232 INTERFACE
OTHER INTERFACES (PARALLEL, CUSTOM)

FIG. 1

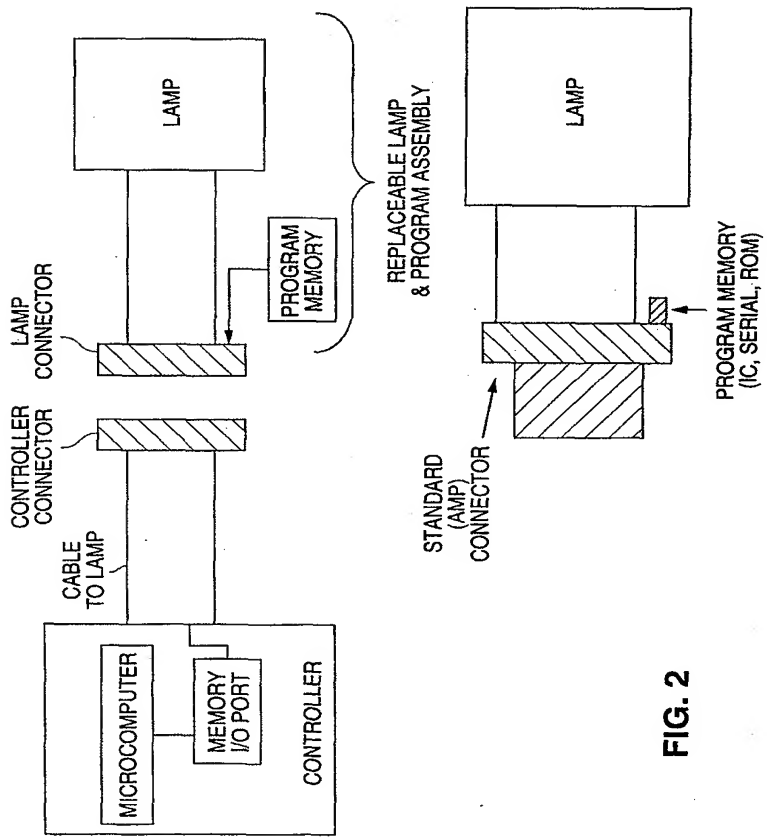

LAMP
PROGRAM MEMORY
REPLACEABLE LAMP & PROGRAM ASSEMBLY
LAMP CONNECTOR
CONTROLLER CONNECTOR
CABLE TO LAMP
MICROCOMPUTER
MEMORY I/O PORT
CONTROLLER
LAMP
STANDARD (AMP) CONNECTOR
PROGRAM MEMORY (IC, SERIAL, ROM)

FIG. 2

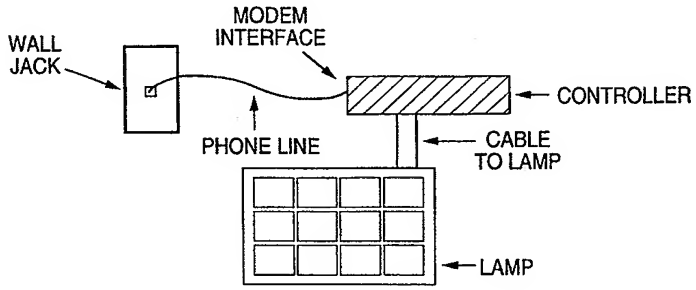

MODEM
INTERFACE
WALL
JACK
CONTROLLER
PHONE LINE
CABLE
TO LAMP
LAMP

FIG. 3

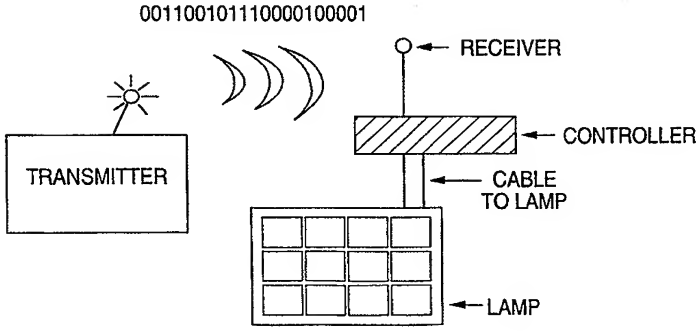

00110010111000010001
RECEIVER
TRANSMITTER
CONTROLLER
CABLE
TO LAMP
LAMP

FIG. 4

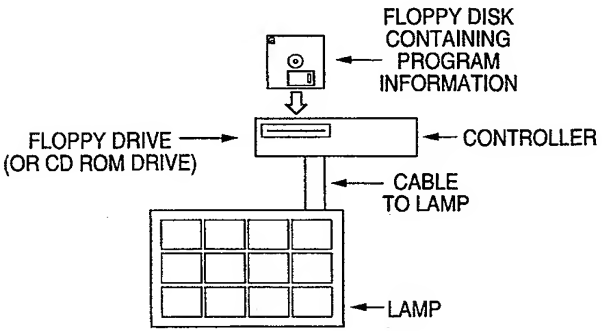

FLOPPY DISK
CONTAINING
PROGRAM
INFORMATION
FLOPPY DRIVE
(OR CD ROM DRIVE)
CONTROLLER
CABLE
TO LAMP
LAMP

FIG. 5

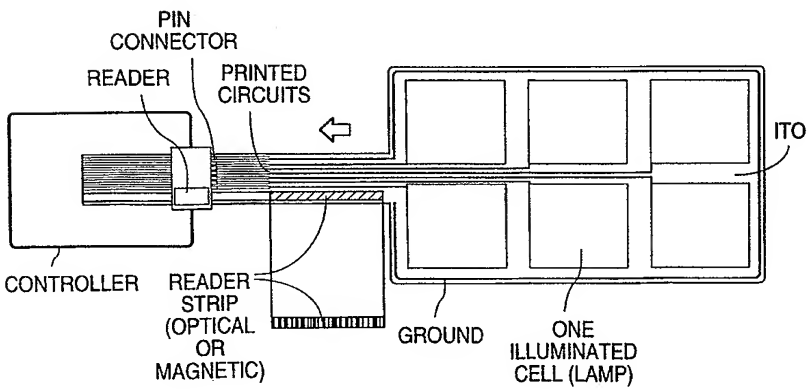

PIN
CONNECTOR
READER
PRINTED
CIRCUITS
ITO
CONTROLLER
READER
STRIP
(OPTICAL
OR
MAGNETIC)
GROUND
ONE
ILLUMINATED
CELL (LAMP)

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/22520

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G09G 3/30
US CL : 345/76

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/76, 77, 82, 1, 2 ; 315/169.1, 169.3; 313/383.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,886,474 A(ASAI ET AL) 23 March 1999, column 6, lines 25-67, column 2, lines 1-51, column 10, lines 15-36, column 11, lines 6-45	1-7, 12
A	US 5,838,289 A (SAITO ET AL) 17 November 1998, column 5, lines 31-67.	1-14
A	US 5,684,368 A (WEI ET AL) 04 November 1997, column 4, lines 30-52.	1-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 10 OCTOBER 2000	Date of mailing of the international search report 03 NOV 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer FRANCIS NGUYEN Telephone No. (703) 308-8558

Form PCT/ISA/210 (second sheet) (July 1998) *

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/22520

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

EAST BRS- Electroluminescent, EL, luminescent display, programmable, control device, microcontroller, motherboard, processor, modem, communication interface, download/upload, memory input port, reader strip, electroluminescent display system, pin connectors.